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ABSTRACT

The Stationary Engineering Laboratory Manual 2 Teacher's Guide was designed as an aid to the instructors of vocational-technical high school students who have received instruction in the basics of stationary engineering. The course of study was developed for students who will be operating a live plant and who will be responsible for supplying steam for heating, cooking, and baking. Each lesson in the teacher's guide lists behavioral objectives, teaching aids, procedures, summary points, testing suggestions, and assignments. The major units are: engineering fundamentals, steam boilers, boiler fittings, boiler room systems, feed-water accessories, steam accessories, fuels, combustion accessories, combustion, boiler plant instruments, boiler water conditioning, compressed air system, electrical, operation, and service and maintenance. (NJ)

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State of New Jersey
Department of Education
Division of Vocational Education

STATIONARY ENGINEERING LABORATORY - 2

TEACHER'S GUIDE

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INTRODUCTION

The Stationary Engineering Laboratory Manual – 2 was designed for students who have already received instruction in the basics of Stationary Engineering. This manual was developed for students who will be operating a live plant. They will be responsible for supplying steam for heating, cooking, baking, and hot water. The plant must always operate; it cannot shut down. Safety is important for both the students and those depending on the students for asupply of steam.

This manual is closely correlated with the Stationary Engineering Related Science Manual – 2.

ASSIGNMENT 1–A–1

Title: Shop Safety

Objectives:

1. Be able to recognize all shop safety rules.
2. Be able to correctly report an accident.

Aids:

1. List of Shop Safety Rules
2. Accident Report Forms
3. Safety Glasses – Pair for each student
4. Card for students to sign with number of safety glasses issued.
5. Set of jeweler's screwdrivers to adjust glasses if necessary.

Procedure:

1. Issue copy of shop safety rules and discuss each rule with class.
2. Explain dangers involved when working around machinery.
3. Stress how industry is very conscious of safety practices and procedures.
4. Issue safety glasses to students and explain their responsibility for care of glasses.
5. Show students where glass cabinet is and where cleaning tissues are kept.
6. Recommend school insurance.

Summarize:

1. Students must wear glasses at all times in shop.
2. Breaking Shop Safety Rules will result in disciplinary action.

Testing:

1. Question students as to whether they feel Shop Safety Rules are valid.
2. Can they add any rules to the list?
3. Check the Accident Report form that they filled out.

Assignment:

Have students complete assignments 1–A–1 in lab manual.

ASSIGNMENT 1–A–2

Title: Handling Fire Fighting Equipment

Objective:

1. Be able to use water, CO_2, and foam extinguishers to put out a fire.

Aids:

1. One Water extinguisher
2. One CO_2 extinguisher
3. One large mason's mixing tub
4. One Foam extinguisher
5. One gallon of gasoline
6. Long-handled torch
7. Large stand-by foam extinguisher.

Procedure:

1. Identify fire extinguishers and explain how they are operated.
2. Set up mason's tub in open area outside.
3. Put water in tub and add gas on top of water.
4. Keep all students away from tub.
5. Have all extinguishers on hand and away from tub.
6. Light torch and ignite gas.
7. Demonstrate use of each extinguisher.
8. Light fire again and have each student use extinguisher to put out fire.

Summarize:

1. Importance of using proper extinguisher.

Testing:

1. What was effect of water on gas fire?

Assignment:

Have student complete assignment 1–A–2 in lab manual.

Note: After demonstration have all fire extinguishers recharged.

ASSIGNMENT 1–A–3

Title: Housekeeping (Painting)

Objectives:

1. Be able to properly mix paint and prepare area for painting.
2. Be able to paint lines, boilers, or auxiliaries in boilerroom as assigned.
3. Be able to properly clean and store brushes and paint cans after painting.

Aids:

1. Brushes
2. Paint stirrers
3. Paint can openers
4. Drop cloths

Procedure:

1. Assign student an area to paint.
2. Issue brush, paint stirrer, and drop cloth.
3. Explain why area must be thoroughly clean and free of oil, grease, etc.
   Note: (All cleaning will be done by 10th grade students.)
4. Show student how to properly open paint can.
5. Demonstrate how to properly mix paint.
6. Explain reason for using drop cloth.
7. Discuss proper way to close cans and clean brushes.
8. Explain to student that the painted area, the cans, and the brushes will be inspected at the end of the assignment.

Summarize:

1. Area must be clean.
2. Paint must be thoroughly mixed.
3. Area must be protected.
4. Clean up thoroughly after painting.

Testing:

1. What is result of leaving paint cans open?

Assignment:

Complete assignment 1–A–3 in Lab Manual.

ASSIGNMENT 1–B–1

Title: Shop Organization and Management

Objectives:

1. Review student responsibility.
2. To know student responsibility in tool crib.
3. To know student responsibility when acting as fireman.

Aids:

1. List of student responsibility 10th grade
2. List tool crib procedure
3. List firemans responsibility
4. Boiler room lab

Procedure:

1. Discuss student responsibility list.
2. Discuss tool crib procedure and duties.
3. Discuss fireman's responsibilities and duties.
4. Show students how to take over a watch with a step-by-step procedure.
5. Carry out Engineer's duties on watch, step-by-step including sample reading and fuel oil soundings.

Summarize:

1. Reason for strict adherence to routine of tool crib and fireman's duties.

Testing:

1. What is the first thing you do when taking over a watch?

Assignment:

Have students complete lab assignment 1–B–1 and file tool crib and fireman procedures in notebook.

ASSIGNMENT 2–B–1

Title: Factor of Evaporation

Objective:

1. Be able to calculate the factor of evaporation of a boiler.

Aids:

Boilers that are in service.

Procedure:

1. Show and explain the formula for this factor of evaporation.

$$\text{Factor of Evap.} = \frac{H_s - (FW-32)}{970.3}$$

2. Explain how to find total heat in the steam from the steam tables.
3. Show where the feed water temperature can be taken for each boiler.
4. Show how to calculate the factor of evaporation.
5. Explain how the factor of evaporation chart is to be filled out.

Summarize:

1. Explain formula
2. Using steam table
3. Using the formula
4. Recording results

Testing:

1. Can the factor of evaporation change on a boiler?
2. What two values can change in the formula?

Assignment:

1. Complete assignment 2–B–1 in lab manual.

ASSIGNMENT 2–B–2

Title: Developed Boiler Horsepower

Objective:

1. Be able to calculate the developed horsepower of a boiler.

Aids:

Boilers in service
Steam flow meter

Procedure:

1. Define boiler horsepower.
2. Show and explain the formula for finding the developed boiler horsepower.

$$H\,P = \frac{W \times Fact\ of\ Evap.}{34.5}$$

3. Show how to read and use the safety valve data such as pounds of steam per hour.

   Note: Total pounds per hour for each boiler.

4. Show and explain how to calculate boiler horsepower from safety value data. This will be maximum H.P.
5. Explain how to determine pounds of steam flow per hour from the steam flow meter.
6. Explain that the horsepower calculated when using the steam flow meter is the actual developed horsepower at that moment.
7. Explain how to calculate horsepower from square feet of heating surface. Stress that this method is not acceptable in New Jersey.
8. Explain how the horsepower chart is to be filled out.

Summarize:

1. Explain formulas.
2. Pounds per hour of steam from:
   safety valves – maximum H.P.
   flow meter – actual H. P.
3. Recording results

Testing:

1. Why can we say that the maximum boiler horsepower for a given boiler can be found if you use the total pounds per hour of steam relieved in the horsepower formula.
2. In actual practice is the developed boiler horsepower constant or changing?
3. What data is necessary before you can find the developed boiler horsepower?

Assignment:

1. Complete assignment 2–B–2 in the lab manual.

ASSIGNMENT 2–C–3

Title: Saturated and Superheated Steam

Objectives:

1. Be able to discuss the pressure-temperature relationship that exists for saturated steam.
2. Be able to determine if steam is saturated or superheated.
3. Be able to use the steam tables.

Aids:

Boilers that are in service
One pyrometer
Steam pressure reducing station

Procedure:

1. Explain that for every pressure there is a corresponding temperature for saturated steam.
2. Demonstrate how to take the temperature readings of the steam and water.
3. Show how to fill out the pressure-temperature chart.
4. State the definition of saturated and superheated steam.
5. Explain what is meant by degrees of superheat.

Summarize:

1. Show where and how the student will take readings and where he is to record these readings.

Testing:

1. Define saturated steam.
2. Define superheated steam.
3. How do we know how many degrees of superheat there are?

Assignment:

Complete assignment 2–C–3 in the lab manual.

ASSIGNMENT 3–A–2

Title: Types of Firetube Boilers

Objective:

1. Be able to identify the various types of firetube boilers and the important features of each type.

Aids:

Firetube Boilers

Procedure:

1. Explain why a boiler is designated as a firetube boiler.
2. Show each firetube boiler to the students and name each type.
3. Draw the students' attention to the following features:
   a. Shape of each boiler
   b. Shape of combustion chamber
   c. Internally or externally fired
   d. Number of gas passes
   e. Up-take damper location.
4. Explain how the types of firetube boilers chart is to be completed.

Summarize:

1. Name each type of firetube boiler and explain why it was given that name.

Testing:

1. Name and describe each type of firetube boiler we have discussed.

Assignment:

Complete assignment 3–A–2 in the lab manual.

ASSIGNMENT 3–A–3

Title: Construction of Firetube Boilers

Objective:

1. Be able to identify the external and internal parts of a firetube boiler.

Aids:

Firetube Boilers

Procedure:

1. Show and explain the function of the following parts of the firetube boilers:

a. handholes	e. firetubes
b. manholes	f. tube sheet
c. water legs	g. stays
d. stay bolts	h. crown sheet

2. Show how to measure the length and diameter of a firetube.
3. Show how to measure the depth of a stay bolt telltale.

Summarize:

1. Give name and explain function of each part of the firetube boiler.

Testing:

1. Which boilers had water legs?
2. Did all boilers contain manholes?
3. Why were there two types of stay bolts?
4. Name the parts of the firetube boiler.

Assignment:

Complete assignment 3–A–3 in the lab manual.

ASSIGNMENT 3–C–1

Title: Boiler Certificates

Objective:

1. Be able to discuss the information that is on a boiler certificate.

Aids:

Steam boilers
Boiler certificates

Procedure:

1. Explain the purpose of a boiler certificate.
2. Show the data a boiler certificate contains and stress the following:
   a. Numbers
   b. Make and year built
   c. Type
   d. M.A.W.P.
   e. S.V. setting
   f. Date of last inspection
   g. Penalty for violations
3. Show where the safety valve name plate data is found. Compare with information on certificate.
4. Show the manufacturers stampings on boiler and compare with data on certificate.

Summarize:

1. Purpose of and information found on boiler certificate.

Testing:

1. Name all data that you can think of, that you would find on a boiler certificate.
2. Why is a boiler certificate necessary?

Assignment:

Complete assignment 3–C–1 in the lab manual.

ASSIGNMENT 4–A–2

Title: Safety Valve (Construction)

Objective:

1. Be able to take a safety valve apart and explain how it is constructed.

Aids:

1. Cut-away pop-type safety valve.

Procedure:

1. Assign student a cut-away pop type safety valve.
2. Explain why and where seals are installed.
3. Point out huddling chamber and its purpose.
4. Explain why only a qualified person is allowed to make safety valve adjustments.
5. Explain why only the manufacturer or his certified representative may make repairs.

Summarize:

1. Location of safety valve
2. Purpose of safety valve
3. Why it pops open.

Testing:

1. Why do you think it necessary for a safety valve to pop open rather than open slowly?

Assignment:

Complete assignment 4–A–2 in lab manual.

ASSIGNMENT 4–B–2

Title: Construction of Bottom Blow-Down Valves

Objectives:

1. Be able to dismantle a quick-closing and screw-type blow-down valve.
2. Be familiar with the parts of a quick-closing and screw-type blow-down valve.

Aids:

1. Cut-away of quick-closing and screw-type valve.
2. Manufacturers data sheets

Procedure:

1. Assign student a cut-away of a quick-closing and a screw-type valve.
2. Explain how valve works and how it connects to boiler.
3. Track flow of water through valve.
4. Point out how slow opening valve is self-cleaning – no sludge build-up.
5. Discuss how to handle blow-down valves in blowing down.

Summarize:

1. Location – which is closest to shell of boiler?
2. Handling valves during blow down.
3. Safety precautions to follow

Testing:

1. Why are special valves needed for blow-down valves.
2. How to handle valves, i.e., blow down.

Assignment:

Complete assignment 4–B–2 in lab manual.

ASSIGNMENT 4–C–1

Title: Construction of Water Column

Objectives:

1. Be able to identify the fittings found on a water column.
2. Be able to explain the purpose of each fitting.

Aids:

1. Two models of water columns.
2. Manufacturers data sheets

Procedure:

1. Assign water column models to students.
2. Point out differences.
3. Explain how to disassemble column.
4. Explain why whistle valve must be removed last.
5. Discuss importance of blowing glass and column.

Summarize:

1. Need for column
2. Importance of blow down

Testing:

1. What do you think would happen if column were not blown-down at regular intervals?

Assignment:

1. Complete assignment 4–C–1 in lab manual.

ASSIGNMENT 4–C–2

Title: Location of Water Column According to A.S.M.E. Code

Objective:

1. Be able to check the proper location of a water column according to A.S.M.E. Code.

Aids:

1. 6′ ruler
2. Boiler off load

Procedure:

1. Explain where water column must be located and what relationship this has with gage glass location.
2. Discuss importance of this location and why it should be checked.
3. Explain how it is possible to have column improperly located.

Summarize:

1. Importance of proper location

Testing:

1. How do you know it is safe to add water to a boiler?

Assignment:

Complete assignment 4–C–2 in lab manual.

ASSIGNMENT 4–D–1

Title: Using Test Gages

Objectives:

1. Be able to use a test gage.
2. Be able to check a pressure gage using a test gage.

Aids:

1. Test gages
2. Siphon
3. 6" adjustable wrench
4. Small Stillson wrench

Procedure:

1. Assign student 2 test gages – one high-pressure gage and one low-pressure gage.
2. Explain how to handle gages.
3. Discuss need for gage protection in reference to siphoning, etc.
4. Explain how to connect gage to test cock.
5. Define fast and slow gage.

Summarize:

1. Need for siphon protection.
2. Reason for using test gage.

Testing:

1. What is meant by fast gage? Slow gage?
2. Which would be more dangerous? Why?

Assignment:

Complete assignment 4–D–1 in lab manual.

ASSIGNMENT 4–D–2

Title: Dead Weight Tester

Objectives:

1. Be able to handle a gage tester.
2. Be able to calibrate a pressure gage using a dead weight tester.

Aids:

1. Dead weight tester
2. Instruction sheet on dead weight tester
3. 3 pressure gages
4. 6" adjustable wrench

Procedure:

1. Assign student 3 pressure gages and dead weight tester.
2. Give student instruction sheet on dead weight tester.
3. Explain procedure to follow in attaching gage to tester to prevent damage.
4. Check student out when he feels he is ready to proceed.

Summarize:

1. Reason for using dead weight tester.
2. Gentle touch needed in handling gages and tester.

Testing:

1. What do you think would happen if you started testing gage and the connections weren't tight?

Assignment:

Complete assignment 4–D–2 in lab manual.

ASSIGNMENT 5–A–1

Title: High-Pressure Feed-Water System

Objectives:

1. Be able to locate the high-pressure feed-water lines.
2. Be able to locate every valve, fitting, and control on the high-pressure feed-water line.
3. Be able to determine every possible way of getting water to the high-pressure boilers.

Aids:

Feed-water systems.

Procedure:

1. Trace the feed-water line from the open feed-water heater to the reciprocating pump and then to the No. 2 boiler.
2. Trace the feed-water line from the condensate tank to No. 2 boiler.
3. Trace the feed-water line from the feed-water heater to the centrifugal pump and then to No. 5 boiler.
4. Trace the feed-water line from the condensate tank to No. 5 boiler.
5. State the name of and explain the purpose of every fitting, control, valve and pump on each line.
6. Stress the importance of knowing how to get water to a high-pressure boiler and the danger of a low-water condition.

Summarize:

1. Repeat tracing of each line.
2. Show the student each fitting, control, valve, and pump as you trace each line.

Testing:

1. Name as many parts as you can that are found on a high-pressure feed-water line.
2. Why is it so important that we know how to get water to a boiler?
3. What are the dangers of insufficient water in boiler?

Assignment:

Complete assignment 5–A–1 in the lab manual.

ASSIGNMENT 5–A–2

Title: Low-Pressure Feed-Water System

Objectives:

1. Be able to locate the low-pressure feed-water lines.
2. Be able to locate every valve, fitting, and control on the low-pressure feed-water line.
3. Be able to determine every possible way of getting water to the low-pressure boilers.

Aids:

Feed-water system

Procedure:

1. Trace with the student each low-pressure feed-water line as follows:
   a. From the low vacuum tank to number one boiler.
   b. From the condensate return tank to No. 1 boiler.
   c. From the high vacuum tank to No. 3 boiler.
   d. From the condensate tank to No. 3 boiler.
   e. From the gravity feed tank to No. 4 boiler.
   f. From condensate return tank to No. 4 boiler.
2. State the name of every fitting valve, control, and pump in each system.
3. Stress that there is as much danger from low water in a low-pressure boiler as there is in a high-pressure boiler.

Summarize:

1. Track each system; name all parts of system.

Testing:

1. Name as many parts of the low-pressure feed-water system as you can.
2. What parts are the same in the high- and low-pressure systems?
3. Which is more dangerous – low water in a high- or low-pressure boiler? Why?

Assignment:

Complete assignment 5–A–2 in the lab manual.

ASSIGNMENT 5–B–1

Title: Fuel Oil System

Objective:

1. Be able to locate the lines, fittings, pumps, valves, and accessories that make up the fuel oil system.

Aids:

No. 6 fuel oil system

Procedure:

1. Trace with the student the fuel oil system starting at the duplex strainers and ending at the fuel oil tank.
2. State the name and purpose of all parts in the system.

Summarize:

1. Repeat tracing of the fuel oil system.

Testing:

1. Name as many parts of the fuel system as you can.
2. What was the purpose of each part that you have named?

Assignment:

Complete assignment 5–B–1 in the lab manual.

ASSIGNMENT 5–B–2

Title: Fuel Oil Tank Soundings

Objectives:

1. Be able to take a fuel oil sounding.
2. Be able to read a fuel oil tank calibration chart.
3. Be able to calculate daily fuel oil consumption.

Aids:

Sounding rod
Tank calibration chart
Key to tank
Varsol and rags

Procedure:

1. Demonstrate how to take a tank sounding.
2. Explain how to use the tank calibration charts.
3. Show students how to calculate daily fuel oil consumption.
4. Explain how the oil readings are to be recorded on the fuel oil log sheet.

Summarize:

1. How to use calibration chart.
2. How to calculate daily fuel oil consumption.

Testing:

1. How do you take a fuel oil sounding?
2. How do you change from feet and inches on the sounding rod into gallons?
3. How can we calculate daily consumption?

Assignment:

Complete assignment 5–B–2 in the lab manual.

ASSIGNMENT 5–B–3

Title: High- and Low-Pressure Gas Systems

Objectives:

1. Be able to locate the parts of the high-pressure system.
2. Be able to locate the parts of the low-pressure gas system.

Aids:

Number 3, 4, and 5 gas burner systems

Procedure:

1. Track the high-pressure gas system going to No. 3 and 4 boilers.
2. Identify and explain the purpose of each part in each system.
3. Trace the low-pressure gas system going to No. 5 boiler.
4. Identify and explain the purpose of each part in the low-pressure system.

Summarize:

1. Trace each system again.
2. Identify the parts and their purpose.

Testing:

1. Name as many parts of each system as you can.
2. Which parts are for safety on each system?

Assignment:

Complete assignment 5–B–3 in the lab manual.

ASSIGNMENT 5–C–1

Title: Draft System

Objectives:

1. Be able to explain the basic draft system in a boilerroom.
2. Be able to locate the forced and induced draft fans.
3. Be able to locate all draft control dampers.
4. Be able to locate all draft gage lines on a boiler.

Aids:

Boilers
Forced and induced draft fans
Dampers

Procedure:

1. Explain how the gases pass through each boiler to the stack.
2. Show where the forced and induced draft fans are located, and explain the function of these fans in the system.
3. Show where the dampers are located, and explain how they control the flow through the boiler.
4. Show where the draft gage connections are tied into each boiler, and trace each line back to the panel board.

Summarize:

1. Repeat the tracing of a gas path through boiler to the stack, showing dampers, fans, and draft gage connections.

Testing:

1. What in your opinion is a draft system in a boiler room?
2. Where are dampers and fans located in a draft system?
3. Why are draft gage lines connected to the boiler?

Assignment:

Complete assignment 5–C–1 in the lab manual.

ASSIGNMENT 6–A–2

Title: Feed Stop and Checks

Objectives:

1. Be able to disassemble a feed-stop and feed-check valve.
2. Be able to identify the parts of a feed-stop and a feed-check valve.

Aids:

1. Globe valve
2. Swing check
3. Manufacturers catalogs
4. Tools needed to dismantle valves

Procedure:

1. Assign valves to students.
2. Discuss types of valves used as stop valves and check valves.
3. Explain how they are found in the feed line and why this position is so important.
4. Discuss pressure stamping on valve body and arrow showing direction of flow.

Summarize:

1. Location and type of valves selected
2. Reason for pressure stampings

Testing:

1. What would happen if a check valve were reversed in line?

Assignment:

Complete assignment 6–A–2 in lab manual.

ASSIGNMENT 6–A–3

Title: Gasket Selection and Measurement

Objectives:

1. Be able to identify the different types of gasket materials and the service they are used for.
2. Be able to take measurements for making a ring gasket.
3. Be able to take measurements for making a full gasket.

Aids:

1. Assorted gasket material
2. Manufacturers catalog
3. Flange
4. Compass
5. Inside and outside calipers
6. Rule
7. Two pieces of poster board 12" x 12"

Procedure:

1. Discuss different types of gasket material and how each type is used.
2. Briefly discuss how to take measurements for a ring gasket and a full gasket.

Summarize:

1. Need for proper gasket material.

Testing:

1. Why are flange gaskets necessary?

Assignment:

Complete assignment 6–A–3 in lab manual.

ASSIGNMENT 6–B–1

Title: Open Feed-Water Heater

Objecctives:

1. Be able to identify the parts of an open feed-water heater and the purpose they serve.
2. Be able to trace the path of steam, water, oxygen, and other non-condensible gases.

Aids:

1. Open feed-water heater in boiler room

Procedure:

1. With heater open, explain where steam condensate and city water lines enter.
2. Show how oxygen and non-condensible gases are vented.
3. Explain purpose of trays and internal overflow.
4. Discuss dangers involved using open feed-water heater in relation to boiler, etc.

Summarize:

1. How heater works.
2. Results of water too hot and water not hot enough.

Testing:

1. What are the dangers to a boiler if feed-water temperature is too hot? if too cold?

Assignment:

Complete assignment 6–B–1 in lab manual.

ASSIGNMENT 6–C–1

Title: Feed-Water Regulator

Objectives:

1. Be able to identify the internal parts of both a mechanical and an electrical feed-water regulator.
2. Be able to describe how both a mechanical and electrical feed-water regulator works.

Aids:

1. Cut-away of McDonnel Miller regulator
2. Cut-away of Copes regulator
3. Electric meter

Procedure:

1. Discuss operation of both regulators.
2. Explain location and why location is so critical.
3. Show the float chamber and point out why blowdown is important.
4. Explain how to use electric meter.

Summarize:

1. Location of regulators
2. Importance of blowdown

Testing:

1. What would happen if sludge were allowed to accumulate in float chamber?
2. What happens to the Copes regulator when it is blown down? Does it open or close? Explain.

Assignment:

Complete assignment 6–C–1 in lab manual.

ASSIGNMENT 6–C–2

Title: Low-Water Cutoff

Objectives:

1. Be able to identify the internal parts of a low-water cutoff.
2. Be able to describe how the low-water cutoff operates.

Aids:

1. Cut-away of low-water cutoff.
2. Cut-away of combination low-water cutoff and feed-water regulator.
3. Electric meter
4. Manufacturers data sheets

Procedure:

1. Discuss operation of low-water cutoff.
2. Discuss operation of combination feed regulator and low-water cutoff.
3. Explain location and why location is so critical.
4. Discuss why it is recommended to have a separate low-water cutoff if a combination control is used.

Summarize:

1. Location and operation
2. Reason for 2nd low-water cutoff when using combination control.

Testing:

1. Describe operation of combination regulator and low-water cutoff.

Assignment:

1. Complete assignment 6–C–2 in lab manual.

ASSIGNMENT 6–C–3

Title: Gasket Cutting

Objectives:

1. Be able to use a gasket cutter.
2. Be able to follow the procedure in cutting a gasket.

Aids:

1. Gasket cutting kit
2. Cutting board
3. Poster board 12" x 12"
4. Rule
5. Sheet packing

Procedure:

1. Discuss parts of gasket cutter and how it works.
2. Show how to set cutter for desired circle.
3. Stress danger of blade and how to handle cutter once blade has been set.
4. Show how to set blade depending on gasket thickness.
5. Assign gaskets to be cut such as fuel oil strainer, feed-water regulator, low-water cutoff, or water column.

Summarize:

1. Care in handling cutter once blade has been exposed.

Testing:

1. Why do you feel it's important to secure cutter blade before leaving a cutter?

Assignment:

Complete assignment 6–C–3 in lab manual.

ASSIGNMENT 6–D–1

Title: Atmospheric Return

Objectives:

1. Be able to locate the condensate tank in a system.
2. Be able to identify all the lines going to and leaving the condensate tank.
3. To know why an automatic city water make-up is used on condensate tanks and how they operate.

Aids:

1. Condensate tank in boilerroom

Procedure:

1. Discuss all lines and fittings found on condensate tank.
2. Discuss reason for the automatic city water make-up.
3. Demonstrate how it works.
4. Explain why tank is vented.

Summarize:

1. Purpose of condensate tank.
2. Reason for automatic city water make-up.

Testing:

1. What would happen if city water make-up were not installed and returns failed to come back in sufficient quantity?

Assignment:

1. Complete assignment 6–D–1 in lab manual.

ASSIGNMENT 6–D–2

Title: Vacuum Tank

Objectives:

1. Be able to locate the vacuum tank in a system and describe how it works.
2. Be able to use pump selector switch when needed.
3. Be able to recognize and correct faulty operation.
4. Be able to identify all the fittings found on a vacuum tank and the purpose they serve.

Aids:

1. Vacuum tank in boilerroom

Procedure:

1. Discuss purpose of vacuum tank in system.
2. Explain selector switch and when it is used.
3. Discuss purpose of thermometer.
4. Explain air vent to atmosphere and what water being discharged from vent would indicate.

Summarize:

1. Purpose
2. Reason for 3-way selector

Testing:

1. If water is being discharged from open vent, what would this indicate to operator?

Assignment:

1. Complete assignment 6–D–2 in lab manual.

ASSIGNMENT 6–E–1

Title: Reciprocating Pumps

Objectives:

1. Be able to completely strip down a reciprocating pump.
2. Be able to thoroughly clean steam and water side of a reciprocating pump.
3. Be able to reassemble and set the valves on a reciprocating pump.

Aids:

1. Cut-away of reciprocating pump
2. Data sheet on how to set valves
3. Tools needed to dismantle pump.

Procedure:

1. Use cut-away of reciprocating pump and review parts and operation.
2. Explain why pump cannot stop in mid-position.
3. Explain what controls steam and exhaust to and from the steam cylinder.
4. Discuss how one valve controls both steam and exhaust.
5. Discuss importance of marking parts before dismantling.
6. Discuss student's responsibility for all pump parts once disassembled.
7. Explain how to set pump in mid-position.
8. Discuss importance of properly securing a reciprocating pump and tagging it out when it is live equipment.

Summarize:

1. Secure and tag out properly.
2. Mark before dismantling.

Testing:

1. Why is it impossible for a pump to stop in mid-position?

Assignment:

Complete assignment 6–E–1 in lab manual.

ASSIGNMENT 6–E–2

Title: Centrifugal Pumps

Objectives:

1. Be able to completely strip down a centrifugal pump.
2. Be able to describe the purpose of all internal parts.
3. Be able to reassemble pump to reassemble and check for free rotation.

Aids:

1. Cut-away of centrifugal pump
2. Manufacturers catalogs
3. Tools needed for dismantling

Procedure:

1. Using cut-away describe internal parts and how they work.
2. Discuss reason for marking pump.
3. Describe procedure to follow in stripping pump.

Summarize:

1. Principles of operation

Testing:

1. Why is it wise to mark pump before stripping?

Assignment:

1. Complete assignment 6–E–2 in lab manual.

ASSIGNMENT 6–E–3

Title: Injector

Objectives:

1. Be able to locate and describe the purpose of a feed-water injector.
2. Be able to trace lines coming to and leaving the injector, and to know the purpose of all valves on these lines.
3. Be able to completely strip an injector, clean it, and reassemble it ready for service.

Aids:

1. Cut-away model of injector
2. Injector in boilerroom

Procedure:

1. Explain internal parts of injector.
2. Discuss lines coming to and leaving the injector.
3. Explain how to secure injector for safe removal.
4. Discuss why steam line feeding injector must come from highest part of steam drum.
5. Discuss purpose of check valve in city water line feeding injector.

Summarize:

1. Theory of operation
2. Need for check in city water line

Testing:

1. What would happen if check valve in city water line failed and injector kicked out.

Assignment:

1. Complete assignment 6–E–3 in lab manual.

ASSIGNMENT 7–A–1

Title: Steam to Water Cycle

Objectives:

1. Be able to sketch and explain the steam to water cycle.
2. Be able to describe how condensate returns to the system.
3. Be able to explain why it is important to save condensate.

Aids:

Boilers
Steam lines
Domestic hot water tank
Vacuum return system

Procedure:

1. Track the steam line as it comes from the boiler to the low-pressure header.
2. From the steam header, trace the steam line to the domestic hot water tank; then trace the condensate line back to the vacuum pump.
3. Show and explain the purpose of each fitting, valve, and control in the system.
4. Describe how heat is removed from steam in the domestic hot water tank; then describe how condensate returns to the vacuum pump.
5. Explain why it is important to save as much condensate as possible for reuse.

Summarize:

1. Repeat tracing the complete system and explain the purpose of all the parts within the system.

Testing:

1. Name all the parts that make up a steam-to-water system.
2. What is the purpose of each part you have named?

Assignment:

1. Complete assignment 7–A–1 in the lab manual.

ASSIGNMENT 7–A–2

Title: Steam Headers

Objectives:

1. Be able to locate and explain the purpose of the high-, medium-, and low-pressure steam headers.
2. Be able to locate and explain the purpose of the cross connections between the high- and the medium-pressure headers and between the medium- and low-pressure headers.
3. Be able to locate and explain the purpose of all the valves on the high-, medium-, and the low-pressure steam headers.

Aids:

High-, medium-, and low-pressure headers and fittings

Procedure:

1. Show, identify, and explain the purpose of each steam header.
2. Show and identify all valves and fittings on each steam header.
3. Show and explain the purpose of the cross connections between each header.
4. Show where the safety valves are located on the medium- and low-pressure headers. Also the location of the safety valve name plate data.

Summarize:

1. Track flow of steam from number two boiler through each header until it leaves low-pressure header.
2. Identify each fitting and valve as you come to it.

Testing:

1. Why do we have safety valves on the low- and medium-pressure steam headers but not on the high-pressure header.
2. Name all parts attached to the headers.
3. What is the purpose of the parts?

Assignment:

Complete assignment 7–A–2 in the lab manual.

ASSIGNMENT 7–A–3

Title: Use of the Nipple Chuck

Objectives:

1. Be able to explain the purpose of a nipple chuck.
2. Be able to use a nipple chuck.

Aids:

Pipe cutting and threading machine
Set of pipe nipple chucks
Black iron pipe
Soap stone
Rule
Safety check-out list

Procedure:

1. Set up pipe threading machine for use. Explain safety practices to be followed while using machine.
2. Explain safety check-out sheet and the need for it to be completed before this assignment is started.
3. Explain the purpose and show the parts of the nipple chuck.
4. Demonstrate how to cut and thread a pipe nipple.
5. Clean up pipe machine, etc.

Summarize:

1. Stress the safety check-out sheet.
2. Explain in detail how to cut and thread a pipe nipple.

Testing:

1. What are some of the possible dangers while using a pipe threading machine?
2. What steps are necessary to cut and thread a pipe nipple?

Assignment:

Complete assignment 7–A–3 in the lab manual.

ASSIGNMENT 7–A–4

Title: Pipe Fitting

Objectives:

1. Be able to lay out a pipe fitting job.
2. Be able to complete a pipe fitting job.
3. Be able to test a pipe fitting job for tightness.

Aids:

Iron pipe and fittings
Tools
Pipe fitting compound

Procedure:

1. Explain the piping layout chart as follows:
   a. Measurements
   b. Center to center
   c. Center to end
   d. End to end
2. Show how to take the above measurements and how to allow for the thread in the fittings.
3. Demonstrate how to cut, thread, and assemble a pipe job according to the layout chart.
4. Show how to check for tightness by connecting to water line.

Summarize:

1. How to measure.
   a. Center to center
   b. Center to end
   c. End to end
2. How to assemble

Testing:

1. What is meant by center to center measurement?
2. What is meant by center to end measurement?
3. What is meant by end to end measurement?

Assignment:

Complete assignment 7–A–4 in the lab manual.

ASSIGNMENT 7–B–1

Title: Main Steam Stop and Automatic Non-Return Valves

Objectives:

1. Be able to identify the internal parts of a main steam stop valve.
2. Be able to identify internal parts of an automatic non-return valve.
3. Be able to describe how an automatic non-return valve functions.

Aids:

Cut-away of a main steam stop valve
Automatic non-return valve
Manufacturers data sheets

Procedure:

1. Dismantle main steam stop valve and name each part. Explain the function of each part and its location in the valve.
2. Show how the valve is assembled and checked for free operation.
3. Dismantle the automatic non-return valve and name each part. Explain the function of each part and its location in the valve.
4. Show how it is assembled and checked for free operation.

Summarize:

1. Name the parts of each valve.
2. Explain how the non-return valve functions.

Testing:

1. Name the parts of a main steam stop valve.
2. Name the parts of an automatic non-return valve.
3. How does an automatic non-return valve work?

Assignment:

Complete assignment 7–B–1 in the lab manual.

ASSIGNMENT 7–B–2

Title: Pressure Regulators

Objectives:

1. Be able to identify the parts of a pressure regulating valve.
2. Be able to describe how a pressure regulating valve functions.
3. Be able to dismantle a pressure regulating valve.
4. Be able to assemble a pressure regulating valve.
5. Be able to test for proper functioning of a pressure regulating valve.

Aids:

Pressure regulating valve
Tools

Procedure:

1. Dismantle pressure regulating valve and name each part.
2. Explain the function of each part and its location in the regulator.
3. Reassemble the regulator showing how each part fits together.
4. Show how it is checked for free movement.
5. Demonstrate how to test regulator with air pressure.

Summarize:

1. Review
   - Dismantling
   - Assembling
   - Testing

Testing:

1. Name the parts of a pressure regulator.
2. What is the purpose of each part?
3. How does the regulator function?

Assignment:

Complete assignment 7–B–2 in the lab manual.

ASSIGNMENT 7–C–1

Title: Non-Return Traps

Objectives:

1. Be able to describe the function of the following traps:
   a. Float
   b. Thermostatic
   c. Inverted bucket
2. Be able to check and service a steam trap.

Aids:

Float steam trap
Thermostatic steam trap
Inverted bucket steam trap
Set of tools, for dismantling and reassembling

Procedure:

1. Disassemble the float steam trap stating the name and function of each part.
2. Place parts in order for assembly. Assemble trap showing how each part fits together.
3. Repeat steps one and two first for the thermostatic trap and then for the inverted bucket steam trap.
4. Explain the need for caution when working on live steam.
5. Show how to secure the steam trap.
6. Show how to remove the steam trap from the steam line.
7. Explain how to clean and service the steam trap.
8. Show how to test steam trap.

Summarize:

1. Explain how to remove steam trap from service.
2. Explain how to clean and service the steam trap.

Testing:

1. Name the parts of each steam trap.
2. How do you secure a steam trap before removing it from the steam line?

Assignment:

Complete assignment 7–C–1 in the lab manual.

ASSIGNMENT 9–A–1

Title: Oil Tanks and Piping

Objectives:

1. Be able to change over fuel oil tanks.
2. Be able to transfer fuel oil from one tank to another.

Aids:

Fuel oil tanks and piping

Procedure:

1. Trace the fuel oil lines to each tank and explain what each stop valve and fitting is for.
2. Show how to change over the fuel oil tanks – first No. 1 to No. 2 and then No. 2 to No. 1.
3. Show how to transfer fuel oil from No. 1 to No. 2 tank and then from No. 2 to No. 1.
4. Explain the possible danger of overflowing the fuel tank while transferring fuel oil.

Summarize:

1. Simulate a change over of fuel oil tanks.
2. Simulate transferring of oil from one tank to another.
3. Stress the need for checking all valve positions before leaving area.

Testing:

1. Can you leave the area while transferring fuel oil? Why?
2. What valves have to be changed when you change over tanks?
3. What valves have to be changed when you transfer fuel oil?

Assignment:

Complete assignment 9–A–1 in the lab manual.

ASSIGNMENT 9–A–2

Title: Fuel Oil Pumps and Heaters (Changing Over)

Objectives:

1. Be able to change over fuel oil pumps.
2. Be able to change over fuel oil heaters.

Aids:

Fuel oil pumps
Fuel oil heaters

Procedure:

1. Trace the flow of oil through the fuel oil pump and the heater.
2. Explain the function of each valve and fitting.
3. Show how to change over the fuel oil pump and the heater.
4. Stress the importance of making sure that all valves are in the correct position.

Summarize:

1. Repeat steps two and three in the procedure.

Testing:

1. Describe the flow of fuel oil as it passes through pump and heater.
2. How do you change over pumps and heaters in the fuel oil system?

Assignment:

Complete assignment 9–A–2 in the lab manual.

ASSIGNMENT 9–A–3

Title: Gear Pumps

Objectives:

1. Be able to dismantle a gear-type pump.
2. Be able to locate and describe the purpose of all internal parts.
3. Be able to reassemble a gear-type pump.

Aids:

Gear pump or model
Manufacturers catalogs

Procedure:

1. Explain the importance of marking the pump before disassembling.
2. Show how to mark the pump.
3. Explain how to disassemble the pump, clean it, and lay out the parts.
4. Identify all parts. Show location and explain the purpose of each part.
5. Explain how to reassemble pump and how to check its moving parts for free movement.

Summarize:

1. How to mark, disassemble, and assemble the gear pump.
2. Name parts of the pump and the purpose of each part.

Testing:

1. What are the moving parts of a gear pump? What are the stationary parts?
2. What is the first thing you must do before disassembling a pump?
3. Explain how you would take a gear pump apart.
4. Explain how you would reassemble the pump.

Assignment:

Complete assignment 9–A–3 in the lab manual.

ASSIGNMENT 9–A–4

Title: Pressure Atomizing Burner

Objectives:

1. Be able to disassemble and assemble a pressure atomizing burner.
2. Be able to identify and state the function of all parts of a pressure atomizing burner.
3. Be able to set up, adjust, and fire off a pressure atomizing burner.

Aids:

Pressure atomizing burner

Procedure:

1. Explain how to disassemble a pressure atomizing burner. Stress the marking of the parts as they are taken apart.
2. Explain how to clean the parts and lay them out for examination.
3. Explain how to reassemble the burner and test for free movement of parts.
4. Show how to set electrodes for correct gap.
5. Show where burner is to be set for test run and explain how the run is to be conducted.
6. Explain how to adjust burner for good combustion.

Summarize:

1. Marking of parts
2. Setting up burner for testing
3. How test run is to be conducted

Testing:

1. Why is it important to mark all parts?
2. How far apart are the electrodes?
3. Explain how you will test burner.

Assignment:

Complete assignment 9–A–4 in the lab manual.

ASSIGNMENT 9–A–5

Title: Rotary Cup Burner

Objective:

1. Be able to disassemble and assemble a rotary cup burner.

Aids:

Rotary cup burner
Tools

Procedure:

1. Explain in detail how to mark the burner before disassembling.
2. Explain how to disassemble all parts of the burner.
3. Explain how to clean and inspect the burner parts for wear.
4. Explain how to reassemble the burner and check for free movement of parts.

Summarize:

1. Stress the need for caution while taking burner apart and assembling it.
2. Stress the importance of inspecting parts for wear.

Testing:

1. Why do you have to work carefully when dismantling or assembling a rotary cup burner?

Assignment:

Complete assignment 9–A–5 in the lab manual.

ASSIGNMENT 9–A–6

Title: Air Atomizing Burner

Objectives:

1. Be able to identify the parts of an air atomizing burner.
2. Be able to perform routine maintenance on the burner.

Aids:

1. Air atomizing burner on No. 2 boiler

Procedure:

1. Show student No. 2 burner and identify parts.
2. Have student make a one-line drawing and show the following parts:
   a. Burner tube
   b. Oil pump and air compressor
   c. Primary air line
   d. Lubricating oil-air tank
   e. Air compressor filter
   f. Modutrol motor
   g. Low-fire adjustment screw, high-fire adjustment screw
   h. Control panel box
   i. Oil solenoid valve
   j. Primary air pressure gage
   k. Primary air adjustment valve
   l. Gas pilot solenoid valve
   m. Lube oil cooler
   n. Oil temperature gage
   o. Air shutter
   p. Fuel oil heater.
3. Trace the fuel oil through the burner and have student show direction of fuel oil flow on drawing.
4. Show student where oil-air tank lube oil level is determined.
5. Show student how to clean air compressor filter.
6. Show student how to clean fuel oil strainer.

Summarize:

1. Have student identify burner parts.
2. Have student perform routine maintenance on burner.

Assignment:

Complete assignment 9–A–6 in the lab manual.

ASSIGNMENT 9–C–1

Title: Gas Piping, Valves, and Fittings

Objectives:

1. Be able to identify the parts of a solenoid valve.
2. Be able to describe how a solenoid functions.
3. Be able to identify the valves and fittings found on a gas line.

Aids:

The solenoids, valves and fittings found on No. 3, No. 4, and No. 5 boilers.

Procedure:

1. Show and name the parts of a solenoid valve, and explain how the valve functions.
2. Explain how to set meter and test coil for continuity.
3. Explain how to reassemble the valve.
4. Name all the valves and fittings on gas lines for boilers No. 3, No. 4, and No. 5.
5. Explain what each valve and fitting is for and show how to read the gas pressure gages.

Summarize:

1. Go over the parts of the gas lines stressing the function of each valve and fitting.

Testing:

1. Name the parts of a solenoid valve.
2. How does the solenoid valve function?
3. What valves and fittings are found on the gas lines on No. 3, 4, and 5 boilers?
4. Explain the purpose of each valve and fitting.

Assignment:

Complete assignment 9–C–1 in the lab manual.

ASSIGNMENT 9–D–1

Title: On-Off Controls

Objective:

1. Be able to adjust the settings on a pressure control, a modulating-pressure control, a vaporstat, and an aquastat.

Aids:

1. Pressure-trol
2. Modulating pressure-trol
3. Vaporstat
4. Aquastat
5. Data sheets
6. Continuity meter
7. Screwdriver

Procedure:

1. Assign controls to student.
2. Discuss operation and use of each control.
3. Discuss location of controls in our plant.
4. Explain importance of examining mercury tube at least once a year.
5. Show student how to use continuity meter.

Summarize:

1. Location and use of controls
2. Danger involved in not checking mercury tubes

Testing:

1. What is meant by operating range?
2. What is meant by high and low fire?

Assignment:

Complete assignment 9–D–1 in lab manual.

ASSIGNMENT 9–D–2

Title: Temperature-Pressure Regulators and Relief Valves

Objectives:

1. Be able to identify the parts of a Temperature-Pressure regulator.
2. Be able to describe how the Temperature-Pressure regulator functions.
3. Be able to identify the parts of an oil-relief valve.
4. Be able to describe how the oil-relief valve functions.

Aids:

Temperature-pressure regulator
Oil-relief valve

Procedure:

1. Show and name the parts of the temperature-pressure regulator.
2. Explain how the temperature-pressure regulator functions.
3. Explain how to disassemble and assemble the temperature-pressure regulator.
4. Show and name the parts of the oil-relief valve.
5. Explain how the oil-relief valve functions.
6. Explain how to disassemble and assemble the oil-relief valve.

Summarize:

1. How to take apart and reassemble the temperature-pressure regulator and the oil-relief valve.
2. Stress clearing and laying out of parts to prevent loss.

Testing:

1. Name the parts of a temperature-pressure regulator.
2. Name the parts of an oil-relief valve.
3. Explain how each functions.

Assignment:

Complete assignment 9–D–2 in the lab manual.

ASSIGNMENT 9–D–3

Title: Programmer

Objectives:

1. Be able to identify the parts of a programming control.
2. Be able to show where the wires on the terminal block go.
3. Be able to check continuity on one pair of wires.

Aids:

1. Fireye programming control
2. Fireye bulletin EP522
3. Continuity meter

Procedure:

1. Assign fireye control to student.
2. Discuss purpose of the control and the location in our plant.
3. Explain importance of the fireman being familiar with the controls operation.
4. Discuss how to use the bulletin to trace terminal wires.
5. Discuss one complete cycle.

Summarize:

1. Go over and complete living cycle.
2. Importance of knowing how the control operates.

Testing:

1. Have student identify cam assembly, flame-relay master relay and lockout switch.

Assignment:

Complete assignment 9–D–1 in lab manual.

ASSIGNMENT 10–C–1

Title: Combustion Process

Objectives:

1. Be able to describe the combustion process as it takes place in an industrial furnace.
2. Be able to describe the factors that can affect the combustion process.

Aids:

Steam boiler that is in use.

Procedure:

1. Explain to the students that you will demonstrate the following factors that affect the combustion process.
   a. Improper fuel-air ratio
   b. Improper atomization of fuel
   c. Reduction of furnace temperature
   d. Insufficient time for the combustion of the fuel.
2. a. Reduce amount of fuel.
   b. Increase amount of fuel.
   c. Explain the results obtained in both instances.
3. Change atomization of the fuel with primary air or oil pressure, and explain the results obtained.
4. Reduce furnace temperature by using a cold boiler or leave furnace off for a 15-minute period. Explain the results obtained.
5. Increase firing rate to maximum to show students that any further increase would not allow sufficient time for complete combustion to take place.

Summarize:

1. Explain the importance of the proper combustion of a fuel in a furnace, prevention of air pollution, and good efficiency to preserve our decreasing fuel supplies.
2. Explain the following:
   a. Mixture of fuel and air
   b. Atomization of fuel
   c. Temperature in combustion zone
   d. Time for the combustion process to go to completion

Testing:

1. What affects the combustion process?
2. How does each factor affect the combustion process?
3. Is it possible to have good combustion efficiency in a furnace and also prevent pollution of the atmosphere?

Assignment:

Complete assignment 10–C–1 in the lab manual.

ASSIGNMENT 10–D–1

Title: Fyrite Analyzer

Objectives:

1. Be able to dismantle, clean, recharge, and assemble a fyrite CO_2 tester.
2. Be able to use a fyrite CO_2 tester.
3. Be able to interpret CO_2 readings.

Aids:

1 Fyrite test kit
2. Replacement parts kit
3 Data sheet

Procedure:

1. Assign necessary material to student.
2. Discuss danger of fluid inside fyrite tester and how to manage it safely.
3. Explain purpose of CO_2 readings.
4. Define CO_2, O_2, and CO.
5. After student has cleaned and recharged tester, explain how to use tester.
6. Check finished results.

Summarize:

1. Dangers of caustic fluid
2. Purpose of testing flue gas.

Testing:

1. What would you do if you spilled some Fyrite liquid on your hands or arms?

Assignment:

Complete assignment 10–D–1 in lab manual.

ASSIGNMENT 10–D–2

Title: Orsat Analyzer

Objective:

1. Be able to prepare an orsat analyzer for testing boiler flue gas.
2. Be able to set up analyzer in boiler room.
3. Be able to take a flue gas analysis using the orsat analyzer.
4. Be able to interpret flue gas readings.

Aids:

1. Orsat tester
2. Chemicals for orsat
3. Instruction sheet

Procedure:

1. Assign necessary material to student.
2. Discuss caution needed when renewing chemicals.
3. Explain how to get orsat ready to take readings.
4. Demonstrate how to take a set of readings.
5. Have student explain how he would proceed to take readings.
6. Using board, show how to interpret reading.

Note:

$CO_2 + O_2 + \frac{1}{2}CO$ should never be:

Above 21 not less than 18.5 with coal

Above 21 not less than 15.5 with oil

Summarize:

1. How to use orsat
2. How to interpret readings

Testing:

1. What does CO_2 represent in flue gas?
2. What does CO represent in flue gas?
3. What does O_2 represent in flue gas?

Assignment:

Complete assignment 10–D–2 in lab manual.

ASSIGNMENT 11–A–1

Title: Differential-Pressure Flow Meter

Objectives:

1. Be able to describe how a differential-pressure flow meter is connected to the line and unit.
2. To know how to blow down the connecting lines.

Aids:

Flow meter and orifice plate

Procedure:

1. Show and explain how the unit is connected to the steam line.
2. Demonstrate how to:
   a. Remove the flow meter from service.
   b. Blow down lines from the orifice plate.
   c. Put meter back into service again.

Summarize:

1. Explain taking meter out of service.
2. Explain blowing down meter.
3. Explain putting meter back into service.

Testing:

1. What is the purpose of blowing down the lines from an orifice plate?
2. How do we blow down the lines?
3. What dangers are there when you remove or place a flow meter of this type into service?

Assignment:

Complete assignment 11–A–1 in the lab manual.

ASSIGNMENT 11–A–2

Title: Positive Displacement and Variable Area Flow Meter

Objectives:

1. Be able to identify the various parts of a positive displacement meter.
2. Be able to disassemble and assemble a positive displacement meter.
3. Be able to describe how the positive displacement meter functions.
4. Be able to identify the various parts of a variable area meter.
5. Be able to disassemble and assemble a variable area meter.
6. Be able to describe how the variable area meter functions.

Aids:

Positive displacement meter
Variable area flow meter

Procedure:

1. Explain how to mark the various parts of the positive displacement meter.
2. Explain how to disassemble the meter.
3. Explain how the parts are to be cleaned and set out for examination.
4. Explain how to assemble meter and to test for leaks.
5. Repeat the above procedure for the variable area meter.

Summarize:

1. How to take each meter apart.
2. How to assemble each meter.
3. How to test for leaks.

Testing:

1. Why is it important to mark the various parts of the meters?
2. How do you go about disassembling a positive displacement meter?
3. How do you go about assembling a variable area meter?
4. How is a meter tested after servicing?

Assignment:

Complete assignment 11–A–2 in the lab manual.

ASSIGNMENT 11–B–1

Title: Calibrating of Draft Gages

Objectives:

1. Be able to use a test manometer to test draft gages.
2. Be able to recalibrate draft gages using a test manometer.

Aids:

Draft manometer
Draft test gages

Procedure:

1. Show and explain how the draft test gage functions.
2. Demonstrate how to take a reading of the furnace and breeching pressure with the test gage.
3. Show and explain how the draft manometer functions.
4. Demonstrate how to take a reading of the furnace and breeching pressures with the draft manometer.
5. Show how to connect the draft manometer to the draft gage of each boiler.
6. Show and explain how to compare readings taken.
7. Show how to recalibrate draft gage for accuracy.
8. Explain how assignment chart is to be completed.

Summarize:

1. Show and explain how each instrument operates.
2. Show how and where each instrument is to be used.

Testing:

1. What is the range of each instrument that we have just used?
2. Why is it important to set the manometer on a level surface to get a zero reading?
3. How can these instruments be damaged through improper use?

Assignment:

Complete assignment 11–B–1 in the lab manual.

ASSIGNMENT 11–C–1

Title: Locating and Describing Thermocouples
(Review of 10th Grade)

Objectives:

1. Be able to find the location of the thermocouples in our plant.
2. Be able to describe what each thermocouple is recording.

Aids:

Thermocouples in boiler room
Recorder and pyrometer

Procedure:

1. Explain the purpose and make-up of a thermocouple.
2. Show where all the thermocouples are in the boiler room.
3. Explain why it is attached to each line.
4. Show how to take a reading with the pyrometer, and check against the recorder.

Summarize:

1. Cover location and purpose of the thermocouples.

Testing:

1. How many thermocouples are there in our boiler room?
2. Do you think it is important that they function accurately?
3. What is the location of thermocouples in our boiler room?
4. What lines are the thermocouples attached to?

Assignment:

Complete assignment 11–C–1 in lab manual.

ASSIGNMENT 11–D–1

Title: Interpreting Recorders

Objectives:

1. Be able to read data from a recorder.
2. Be able to use the integrator reading on flow recorders.
3. Be able to use all data taken from recorders.

Aids:

Brown recorder
Hay's recorder

Procedure:

1. Explain how to read a brown recorder correctly. Show how the chart lines are divided.
2. Explain how to read the pressure from a Hay's steam flow recorder.
3. Explain how to read the flow from a Hay's steam flow recorder.
4. Explain the integrator reading and show how to calculate total steam generated over a 24-hour period.

Summarize:

1. Readings of each recorder
2. Integrator calculations

Testing:

1. Have students read charts and see if they all arrive at the same data.
2. How is the total steam generated for a 24-hour period known to the operator?

Assignment:

Complete 11–D–1 in the lab manual.

ASSIGNMENT 11-E-1

Title: Maintaining Smoke Indicators

Objectives:

1. Be able to clean a haze gage.
2. Be able to check the light source.
3. Be able to change the lamp in the haze gage.

Aids:

1. Haze gages in the boilerroom

Procedure:

1. Explain how the haze gage functions. Show source of light and how to check for correct light.
2. Demonstrate how to clean the lenses.
3. Stress switching off haze gage before starting to clean lenses.
4. Switch off gage at panel board.
5. Show how to remove the old bulb and replace it with a new one.
6. Show how to check lenses for clarity.

Summarize:

1. Switching off the unit before starting.
2. Cleaning the lenses.
3. Removing and replacing bulb.

Testing:

1. What is the first thing you do before cleaning the lenses?
2. Why is it important to clean the lenses in the haze gage?
3. How do you change the light source in a haze gage?

Assignment:

Complete assignment 11-E-1 in the lab manual.

ASSIGNMENT 12–B–1

Title: Internal Feed-Water Treatment

Objectives:

1. Be able to collect boiler water samples.
2. Be able to test boiler water samples.

Aids:

1. Test cabinet
2. Feed-water logs
3. Sampling bottles
4. Gloves
5. Feed-water instruction book

Procedure:

1. Open test cabinet and demonstrate how to get it ready to run tests.
2. Explain how to keep a feed-water log.
3. Show where log, control sheet, and instruction book is kept.
4. Discuss need for clean equipment.
5. Demonstrate how to draw sample from boiler. Stress importance of using gloves and bottle holder to prevent burns.
6. Stress importance of good blow down to clear lines.
7. Run one complete set of test-log results.

Summarize:

1. Need for clean equipment.
2. Safety – need for gloves.

Testing:

1. Why must lines be blown down before drawing a sample?

Assignment:

Complete assignment 12–B–1 in lab manual.

ASSIGNMENT 12–C–1

Title: Chemical Control Methods

Objectives:

1. Be able to mix feed-water chemicals.
2. Be able to add chemicals to boiler water.

Aids:

1. Feed-water chemicals
2. Chemical buckets
3. Gloves
4. By-pass feeder

Procedure:

1. Discuss how to handle and mix chemicals – stress the safety precautions.
2. Explain why all spills should be flushed away with water.
3. Explain how to isolate by-pass feeder.
4. Demonstrate how to add chemicals to by-pass feeder and how to put feeder on line feeding the boiler.
5. Discuss need for care in handling chemicals in storage.

Summarize:

1. Trace lines before opening valves.
2. Flush any spills with plenty of water.

Testing:

1. Why are chemicals added to boiler water?

Assignment:

Complete assignment 12–C–1 in lab manual.

ASSIGNMENT 12–C–2

Title: Blow-Down Tank

Objectives:

1. Be able to remove blow-down tank from service.
2. Be able to drain and clean blow-down tank.
3. Be able to replace gasket, close up, and put tank back in service.

Aids:

1. Bottom blow down tank
2. Safety signs

Procedure:

1. Discuss need for safety signs and reason engineer in charge must be notified before opening blow down tank.
2. Point out how internal overflow works.
3. Show how vent line goes into stack to prevent pressure build up.

Summarize:

1. Do not open up without first putting out signs and notifying watch engineer.

Testing:

1. What would happen if boiler was blown down while blow down tank is open?

Assignment:

Complete assignment 12–C–2 in lab manual.

ASSIGNMENT 13–B–1

Title: Components

Objectives:

1. Be able to trace the compressed air system in our plant.
2. Be able to tie in any compressor we have to our control air system.

Aids:

1. Air compressor lines in our plant

Procedure:

1. Discuss importance of knowing how to tie in shop air with control air.
2. Explain why we need control air.
3. Discuss what happens when we lose our control air.
4. Explain the term "fail safe."

Summarize:

1. Need for control air
2. Fail safe

Assignment:

1. Complete assignment 13–B–1 in lab manual.

ASSIGNMENT 13–C–1

Title: Compressor Operation

Objectives:

1. Be able to start and put air compressors on the line.
2. Be able to stop and take air compressor off the line.
3. Be able to blow down compressor tank.
4. Be able to drain compressor tank.
5. Be able to take time checks for proper running conditions.

Aids:

1. All air compressors in shop
2. Watch for timing

Procedure:

1. Explain why oil level is important.
2. Discuss danger in not draining compressor tank.
3. Explain all safety checks and why they are necessary.
4. Discuss the purpose of timing compressor from O #'s to 80 #'s.

Summarize:

1. Always check equipment for lubrication, tools, and rags before starting.

Testing:

1. Why is it so necessary to keep compressor tank free of all condensate?

Assignment:

Complete assignment 13–C–1 in lab manual.

ASSIGNMENT 13–D–1

Title: Compressor Maintenance

Objective:

1. Be able to disassemble, overhaul, reassemble, and test an air compressor.

Aids:

1. Air compressor
2. Data sheet

Procedure:

1. Assign an air compressor to student.
2. Discuss importance of marking and protecting all parts.
3. Explain that compressor must run to get a completed grade.

Summarize:

1. Mark before disassembling.

Testing:

1. Why do you think it is important to mark your compressor before taking it apart?

Assignment:

Complete assignment 13–D–1 in lab manual.

ASSIGNMENT 14–A–1

Title: Electrical Safety

Objective:

1. Be able to use proper safety practices and procedures when working with electrical equipment.

Aids:

1. Electrical safety rules

Procedure:

1. Discuss safety rules.
2. Explain the dangers of working with electrical equipment.
3. Explain why power tools must be grounded.
4. Discuss and demonstrate how to kill an electrical circuit and how to test to make sure it's dead.
5. Stress importance of using tester and not fingers to test for live equipment.
6. Explain why standard drop light should never be used in steam and water side of a boiler.
7. Demonstrate how to use a fuse puller.
8. Discuss why it is important to keep electrical equipment dry when washing down.

Summarize:

1. AN ELECTRICAL CIRCUIT CANNOT THINK – YOU CAN – THINK SAFETY AND BE SAFE.

Testing:

1. Why should you kill an electrical circuit before working on it?
2. On a three-wired cord, which wire is the ground?

Assignment:

Complete assignment 14–A–1 in lab manual.

ASSIGNMENT 14–B–1

Title: Electrical Circuits (Review of 10th Grade)

Objectives:

1. Be able to lay out a series circuit.
2. Be able to lay out a parallel circuit.
3. Be able to lay out a series parallel circuit.

Aids:

1. No. 16 insulated wire
2. Two sockets and lights
3. Two switches (single pole)
4. Testing meter
5. Receptacle plug

Procedure:

1. Show how to lay out a series circuit.
2. Explain and demonstrate how to check out circuit with a test meter.
3. Show how to lay out a parallel circuit, and explain how to check it out with a test meter.
4. Show how to lay out a series parallel circuit, and explain how to check out circuit with a test meter.

Summarize:

1. Trace out the series, parallel, and series parallel circuits.
2. Explain continuity test

Testing:

1. Can you think of what type of controls would be wired in series?
2. What type in parallel?
3. What type in series parallel?

Assignment:

Complete assignment 14–B–1 in lab manual.

ASSIGNMENT 14–B–2

Title: Basic Burner Control Circuit

Objective:

1. Be able to describe how the pressure-trol, aquastat, and low-water cutoff are connected in a boiler control circuit.

Aids:

Pressure-trol
Aquastat
Low-water cutoff
Lamp and socket
Test meter

Procedure:

1. Make a line drawing on the blackboard to show how to connect the pressure-trol, aquastat, low-water cutoff, and lamp in series.
2. Demonstrate the series circuit by using the above components.
3. Show and explain how to check the completed circuit for grounds, shorts, and continuity.
4. Demonstrate how each control functions in the control circuit.

Summarize:

1. Connecting of the circuit
2. Checking for shorts and grounds
3. How each control functions

Testing:

1. What type circuit was discussed?
2. Why is it a series circuit?
3. Why is it necessary to check the completed circuit for grounds, shorts, and continuity before connecting to a power source?

Assignment:

Complete 14–B–2 in the lab manual.

ASSIGNMENT 14–C–1

Title: Starters, Relays, and Switches

Objectives:

1. Be able to disassemble, clean the contacts, and assemble a motor starter.
2. Be able to clean relays and switches.

Aids:

1. Motor starter
2. Relay
3. Switch

Procedure:

1. Show and explain how to disassemble and clean the motor starter.
2. Demonstrate how to dress the contacts in the starter.
3. Show how to test the starter.
4. Show and explain how to disassemble and clean relay.
5. Show how to test the relay.
6. Show how to examine and clean the switch.

Summarize:

1. Care in disassembling starter and relay
2. Care in the dressing of the contacts
3. Testing after completion of each component

Testing:

1. How could any of the components used in this assignment be damaged?
2. Is it possible to dress a contact too much?
3. Why is it necessary to test carefully after assembling each component?

Assignment:

1. Complete assignment 14–C–1 in the lab manual.

ASSIGNMENT 14–C–2

Title: Fuses, Breakers, and Heaters

Objective:

1. Be able to test fuses and breakers.
2. Be able to replace a fuse.
3. Be able to replace a heater.

Aids:

Assorted fuses, breakers, and heaters
Fuse pullers
Fuse box
Motor starter
Test meter (voltage and continuity)

Procedure:

1. Show and explain how to test a fuse and circuit breaker.
2. Take apart and show how to replace the link in a cartridge fuse.
3. Show how to pull and replace cartridge fuses using a fuse puller.
4. Show how to remove the heaters from the starter and how to compare the numbers.
5. Show how to replace heaters in the starter.

Summarize:

1. Testing fuses and breakers
2. Removing and replacing fuses and heaters

Testing:

1. Why is it necessary to test fuses and breakers?
2. Why do we use a fuse puller to remove and replace cartridge fuses?
3. Is it important to have the correct heater in a starter? Why?

Assignment:

Complete assignment 14–C–2 in the lab manual.

ASSIGNMENT 14–D–1

Title: Types and Uses of Meters

Objectives:

1. Be able to describe the various types of electrical meters.
2. Be able to show how to use the various types of electrical meters.

Aids:

Voltage meter
Amp meter
Ohm meter
Continuity meter
Motor

Procedure:

1. Explain the use of each meter and how it is to be used.
2. Show and explain how to check for continuity through the motor windings.
3. Show how to check the windings for a resistance reading.
4. Show how to use the amp meter to check amperage on motor.
5. Show how to take a voltage reading with the volt meter.

Summarize:

1. How to identify the various types of meters.
2. How to use the various types of meters.

Testing:

1. Name the types of meters used.
2. What is the use of each meter?
3. What is a continuity test?
4. What purpose do electrical meters serve?

Assignment:

Complete assignment 14–D–1 in the lab manual.

ASSIGNMENT 15–A–1

Title: Taking Over and Maintaining a Shift

Objectives:

1. Be able to take over a shift.
2. Be able to maintain a shift.

Aids:

1 – Boilerroom
2 – Boilerroom log
3 – Student fireman responsibility list

Procedure:

1. Discuss fireman's duties and responsibilities in industry.
2. Issue copy of boilerroom log. Explain purpose of log and why it is necessary to maintain accurate readings.
3. Take student to boilerroom and go over the procedure of relieving a watch.
4. Have student follow the same procedure.
5. With student present, perform all the duties necessary to maintain a shift.
6. Have student follow the same procedure.

Summarize:

1. Importance of reporting early
2. Fireman's duties and responsibilities

Testing:

1. Why should you report early to take over a shift?
2. Who can decide how long the operator can leave his equipment?
3. Why do firemen require a license?

Assignment:

Complete assignment 15–A–1 in lab manual.

ASSIGNMENT 15–A–2

Title: Assisting in Plant Start-Up and Shut-Down

Objectives:

1. Be able to help start up a dead plant.
2. Be able to help secure a live plant.

Aids:

1. Boilerroom

Procedure:

1. Discuss the importance of developing a set routine to follow when starting up or securing a plant.
2. Explain why it is so important to make safety checks before starting up the plant.
3. Discuss and stress the importance of never walking away from a boiler that has just been started until all controls have been tested and you know that they are operative.

Summarize:

1. SAFE OPERATORS ARE MADE – NOT BORN.

Testing:

1. Why do you think it would be dangerous to walk away from a plant that had just been started?

Assignment:

Complete assignment 15–A–2 in lab manual.

ASSIGNMENT 15–A–3

Title: Fuel Change Over

Objective:

1. Be able to change burner over from gas to oil or oil to gas.

Aids:

1. Combination burners in boilerroom

Procedure:

1. Discuss reason for combination burners.
2. Discuss advantage of quick change over.
3. Discuss arrangements with gas company for change over.

Summarize:

1. Advantages of combination burners.

Testing:

1. Which type of fuel would you rather burn? Why?

Assignment:

Complete assignment 15–A–3 in lab manual.

ASSIGNMENT 15–B–1

Title: Draft Adjustments

Objectives:

1. Be able to adjust furnace draft for automatic operation.
2. Be able to adjust furnace draft for manual operation.

Aids:

1. Boilerroom

Procedure:

1. Discuss the importance of controlling draft in furnace operation.
2. Discuss the advantages of automatic draft control over manual control.
3. Explain how draft is measured.

Summarize:

1. Advantages of automatic draft control.

Testing:

1. What is draft and how is it measured?

Assignment:

Complete assignment 15–B–1 in lab manual.

ASSIGNMENT 15–B–2

Title: Oil and Gas Adjustments

Objectives:

1. Be able to describe where various oil and gas adjustments can be made that will affect operating conditions.
2. Be able to describe how these adjustments affect operating conditions.

Aids:

1. Boilerroom
2. Charts attached

Procedure:

1. Discuss importance of knowing where and what type of adjustments are possible.
2. Discuss effects on system when adjustments are off.
3. Explain how this ties in with a well kept boilerroom log.
4. Explain how this is the difference between a good or a half-baked fireman.

Summarize:

1. Temperatures and pressure are signs of good, fair, or poor operating conditions

Testing:

1. How would cold oil in storage tank affect operating conditions?

Assignment:

Complete assignment 15–B–2 in lab manual.

ASSIGNMENT 15–C–1

Title: High- or Low-Water Condition

Objective:

1. Be able to handle high-or low-water conditions.

Aids:

1. Boilerroom – boiler on line

Procedure:

1. Discuss danger of high and low water.
2. Discuss location of gage glass in relation to heating surface.
3. Explain how to use try cocks, what readings are normal, and how to handle abnormal readings.

Summarize:

1. Most important function of fireman is to maintain proper water level at all times.

Testing:

1. Why is it dangerous to add water to a boiler if there is no water in the gage glass and no water when bottom try cock is opened?

Assignment:

Complete assignment 15–C–1 in lab manual.

ASSIGNMENT 15–C–2

Title: Flame Failure

Objectives:

1. Be able to recognize when boiler has had a flame failure.
2. Be able to put boiler back in service after a flame failure.

Aids:

1. Boilerroom – boiler on line

Procedure:

1. Explain how you can recognize the difference between a flame failure and low-water shut down.
2. Discuss procedure to follow when burner is off on a flame failure.
3. Demonstrate how to reset programmer.

Summarize:

1. How to recognize a flame failure.
2. How to correct a flame failure.

Testing:

1. What is the reason for inspection of firebox and purging before attempting to light off?

Assignment:

Complete assignment 15–C–2 in lab manual.

ASSIGNMENT 16–A–1

Title: Cleaning Fire Side

Objectives:

1. Be able to use mechanical boiler cleaning tools.
2. Be able to clean furnace and tubes in a fire-tube boiler.

Aids:

1 – Boiler cleaning tools (air or electric)
2 – Scaffold
3 – Gloves, mask, and goggles
4 – Wire brushes
5 – Vacuum
6 – Boiler to be cleaned

Procedure:

1. Discuss the reasons for cleaning boiler fireside.
2. Explain why goggles, mask, and gloves should be used.
3. Demonstrate how to use goggles and mask.
4. Explain why signs must be hung and controls tagged.
5. Demonstrate how scaffold is set up.
6. Show how to open up fireside of boiler and how to secure doors.
7. Demonstrate how mechanical tube cleaner works.
8. Have each student punch one tube and observe that all safety precautions are being followed.

Summarize:

1. Reasons for cleaning
2. Safety steps to follow

Testing:

1. Why is it necessary to lock out controls and hang signs on a boiler that is off the line for cleaning?

Assignment:

Complete assignment 16–A–1 in lab manual.

ASSIGNMENT 16–A–2

Title: Cleaning Water Side

Objectives:

1. Be able to remove, clean, and replace handhole and manhole covers.
2. Be able to thoroughly clean the water side of a firetube boiler.

Aids:

1. Boiler to be cleaned
2. Gaskets

Procedure:

1. Discuss reasons for cleaning water side.
2. Explain danger of scale sludge deposits.
3. Explain how to lock out controls and the reason for signs.
4. Discuss reason for venting boiler before opening.
5. Discuss reason for flushing as soon as boiler is dumped.
6. Stress importance of securing any tagging out bottom blow-down valves after dumping.
7. Discuss importance of clean surface for gasket replacement.

Summarize:

1. Safety precautions to follow before and after dumping.

Testing:

1. Why is it necessary to close and tag out bottom blow-down valves before entering steam and water side of boiler?

Assignment:

Complete assignment 16–A–2 in lab manual.

ASSIGNMENT 16–A–3

Title: Boiler Inspection

Objectives:

1. Be able to assist in getting a boiler ready for inspection.
2. Be able to remove and replace a fusible plug.
3. Be able to locate and remove all plugged tees.
4. Be able to assist in removing tops of feed-water regulators for cleaning and internal inspection.

Aids:

1 – Boiler
2 – Fusible plug
3 – Rope
4 – Teflon tape

Procedure:

1. Discuss state law on boiler inspection.
2. Discuss merits of having boilers inspected.
3. Explain which fusible plug to use.
4. Demonstrate how to use teflon tape.
5. Discuss all safety precautions to be followed before, during, and after boiler inspection.

Summarize:

1. State law on boiler inspection.
2. Safety procedures to follow.

Testing:

1. Why do you think it important for all personnel working in the boilerroom to be familiar with safety procedures to follow before, during, and after boiler inspection.

Assignment:

1. Complete assignment 16–A–3 in lab manual.

ASSIGNMENT 16–A–4

Title: Laying Up a Boiler

Objective:

1. Be able to assist in laying up a boiler – wet or dry.

Aids:

1. Boiler firetube

Procedure:

1. Explain why laying up a boiler is necessary.
2. Discuss laying up a boiler – wet and dry.
3. Discuss how to decide which method would be best for the plant involved?

Summarize:

1. Two methods of laying up boilers.
2. Damage possible if boiler is not layed up.

Testing:

1. How do you decide if a boiler is to be layed up wet or dry?

Assignment:

Complete assignment 16–A–4 in lab manual.

ASSIGNMENT 16–A–5

Title: Replacing Gage Glass

Objectives:

1. Be able to describe how the internal parts of gage glass fittings are constructed.
2. Be able to measure and cut a gage glass to size.

Aids:

Gage glass cutter
Gage glass
Gage glass washers
Model of gage glass fittings

Procedure:

1. Show and name the parts of the glass and the fittings.
2. Demonstrate how to take the measurement for the length of a new gage glass, explaining why ¼" is subtracted from the overall measurement.
3. Demonstrate how to cut the gage glass to the correct length.
4. Show how to install the new gage glass stressing not to tighten nuts too tight.

Summarize:

1. Measuring for a new glass
2. Cutting of the glass
3. Installing the new glass

Testing:

1. How do you measure for a new gage glass?
2. Can you explain how to use the glass cutter?
3. Why is it important not to tighten the nuts too much?

Assignment:

Complete 16–A–5 in the lab manual.

ASSIGNMENT 16–B–1

Title: Rotary Cup Burner

Objective:

1. Be able to perform routine service and maintenance on a rotary cup burner.

Aids:

Rotary cup burner

Procedure:

1. Show and explain how to secure a rotary cup burner.
2. Show how to mark the fan housing and how to remove the cover.
3. Explain how to clean the cover, housing, and fan. Stress the importance of checking the air switch tubing to make sure it is clear.
4. Demonstrate how to clean and check for free movement of the primary air damper.
5. Show how to remove the burner cup.
6. Show and explain how to remove the solenoid valve and burner tube.
7. Demonstrate how to clean the solenoid valve and burner tube.
8. Show how to check for the correct alignment and any wear or tear of the belts or pulleys.
9. Demonstrate how to reassemble the following:
   a. Burner tube and solenoid valve
   b. Burner cup
   c. Fan housing (check for alignment)
10. Show how to check for correct operation.

Summarize:

1. Securing procedure
2. Danger of forcing parts apart or together with the use of a hammer or lever.
3. Stress the importance of informing instructor of any problems involving removing or assembling of any part.

Testing:

1. What is the purpose of routine service to a rotary cup burner?
2. In what sequence is the burner taken apart?
3. Explain how the burner is reassembled.

Assignment:

Complete assignment 16–B–1 in the lab manual.

ASSIGNMENT 16–B–2

Title: Air Atomizing Burner

Objectives:

1. Be able to clean the burner assembly on an air atomizing burner.
2. Be able to clean the air filter on an air atomizing burner.

Aids:

Air atomizing burner

Procedure:

1. Demonstrate how to secure the burner.
2. Show and explain how to disconnect the oil and gas lines.
3. Show and explain how to remove the burner assembly: stress how to remove the electrode wires as the burner is being removed.
4. Explain how the burner assembly is to be cleaned.
5. Show how to check the electrodes for the correct gap.
6. Show how to set the correct gap.
7. Show and explain how to reassemble burner assembly and reconnect the electrodes, gas lines, and oil lines.
8. Demonstrate how to clean the air intake filter.
9. Show and explain the cleaning of the complete burner.

Summarize:

1. Securing procedure
2. Removal of burner assembly and possible damage to burner.
3. Replacing burner assembly

Testing:

1. Why is a burner serviced on a routine basis?
2. Explain how the burner assembly is removed.
3. Explain how the burner assembly is reassembled.

Assignment:

Complete assignment 16–B–2 in the lab manual.

ASSIGNMENT 16–B–3

Title: Gas Burner

Objective:

1. Be able to clean the blower and the butterfly valve on a gas burner.

Aids:

Gas burner

Procedure:

1. Demonstrate how to secure the gas-fired burner.
2. Show and explain how to remove the blower from the blower housing.
3. Explain how the blower and the housing is to be cleaned.
4. Show and explain how to replace blower in the housing and how to check for correct alignment.
5. Explain how the butterfly valve is to be cleaned and checked for free movement.
6. Explain how the complete burner is to be cleaned.

Summarize:

1. Securing the burner.
2. Removing and installing the blower
3. Importance of having the correct alignment between the blower and housing.

Testing:

1. How do you secure a gas burner?
2. How do you remove a blower from its housing?
3. Why is it important to have the butterfly valve work freely?

Assignment:

Complete assignment 16–B–3 in the lab manual.

ASSIGNMENT 16–C–1

Title: Valve-Stem Packing

Objectives:

1. Be able to measure valve-stem packing.
2. Be able to cut valve-stem packing.
3. Be able to pack a valve stem.

Aids:

Valve
Valve-stem

Procedure:

1. Demonstrate how to secure the valve so that it is safe to repack.
2. Show how to remove the nuts and the packing gland.
3. Show and explain how to remove the old packing and inspect for small particles.
4. Show and explain how to measure for the correct size packing.
5. Demonstrate how to cut the packing to the correct length.
6. Explain how to insert the rings starting at the top and having the opening 120° apart from one ring to the next ring.
7. Show and explain how to replace gland and chase nuts if necessary.

Summarize:

1. Measuring for the correct packing size.
2. Cutting the packing to the correct length.
3. Installing the packing in the gland.

Testing:

1. How do you measure for the correct packing size?
2. Why is it important to clean all old packing out of the packing gland?
3. What steps do you follow in packing a valve?

Assignment:

Complete assignment 16–C–1 in the lab manual.

ASSIGNMENT 16–C–2

Title: Sump Pump

Objective:

1. Be able to assist in the routine maintenance of a sump pump.

Aids:

Sump pump in the boilerroom

Procedure:

1. Show how to secure pump; stress testing electrically to be sure power is off.
2. Explain how to disconnect the pump electrically and how to disconnect pump from the piping.
3. Explain how the hoist is to be set up and the safety precautions to follow.
4. Explain how the pump is to be lifted and then lowered to the ground.
5. Explain the cleaning process and the points that have to be checked:

   Lubrication
   Bearing wear
   Impeller
   Casing
6. Explain how to replace pump in sump pit. Caution against damage to lines while installing pump.
7. Explain how to reconnect electrical connections.

Summarize:

1. Rigging must be checked before raising or lowering pump.
2. Safety procedures to be followed during this assignment.

Testing:

1. What is the purpose of removing the pump?
2. What dangers are there in raising and lowering the pump?

Assignment:

Complete assignment 16–C–2 in the lab manual.